



Communities of the Future

Energy
Programs
for Livable
Communities



U.S. Department
of Energy

Office of Energy
Efficiency and
Renewable Energy

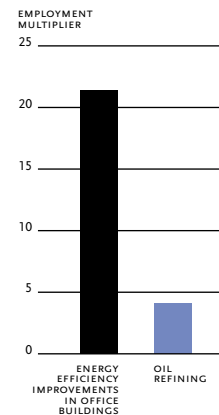
Livable Communities

NREL/PX 04093 WARREN GRETZ



Quality of life and strong, sustainable economic growth go hand in hand.

affordable housing, and promote industrial competitiveness. They often represent the greatest return on investment communities can realize on their energy dollars. For example, a recent report by the State of Texas shows that investing in improving the energy efficiency of office buildings generates almost five times as many jobs in the state as the same investment in oil refining (see Figure 1).



Jobs Resulting from \$1 Million Investment in Texas

Figure 1: Analysts use employment multipliers obtained from input-output analyses to compare the effects of different types of investments on state and local economies. Because energy efficiency involves purchasing and installing equipment locally, its employment multiplier is higher than that for conventional energy projects.

Recently the President's Committee of Advisors on Science and Technology reported that research and development (R&D) investments in energy efficiency have contributed to efficiency improvements that now save U.S. consumers \$170 billion a year.

The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (DOE/EERE) helps communities across the country deal with issues of livability and sustainable growth. Through its regional offices, DOE/EERE can help you identify the right combination of sustainable energy technologies for your community. ■

DOE/EERE can provide resources to help address specific problems in your community.

How we use energy has a profound effect on our environment, our economy, and our quality of life. Every time we flip a light switch or drive our car, we burn fuel, which can have an impact on local air and water quality. At the same time, energy is a cornerstone of local economies; without it, we are literally powerless. Energy is among the largest national industries, representing hundreds of billions of dollars.

Energy efficiency and renewable energy technologies are the key to ensure both environmental quality and economic progress. Energy efficiency uses new technologies to obtain greater benefits at lower costs. Renewable energy uses resources, such as solar, wind, hydropower, fuels made from crops and plants (biomass), and heat generated by the earth (geothermal) to provide cleaner energy, often from local sources, with less environmental impact.

Energy efficiency and renewable energy technologies create jobs, keep money circulating in local economies, prevent pollution, improve the health of local citizens, reduce taxes, create

Contents

- 1 Sustainable Growth
- 2 Buildings for the 21st Century
- 5 Clean Power for the Millennium
- 8 Industries of the Future
- 10 Community Transportation Choices
- 12 Resources in the States

Sustainable Growth

New technologies allow us to achieve both economic development and environmental quality.

Historically, proponents of economic development and environmentalists have glared at each other across tabletops of planning sessions and city council meetings. But today, these former opponents are charting a new course, one which provides prosperity without pollution.

Sustainable development is a common sense approach to change. Simply stated, the concept applies a systems approach to community development: considering economics, environment, and quality of life in an integrated way. Using forethought and a growing number of new technologies and practices, we can achieve both economic development and improved environmental quality. Both are needed to boost the health and welfare of community residents and visitors.

Center of Excellence for Sustainable Development

To help communities explore how sustainable energy can help them achieve their developmental objectives, DOE/EERE maintains a Web site known as the “Center of Excellence for Sustainable Development.” Located at www.sustainable.doe.gov, the site is a repository of information where visitors can share their ideas and hopes for a better future. Specifically, it includes materials designed to:

- Help communities discover how sustainable development can apply directly to them
- Show how sustainable development is being practiced across the country



More and more communities are asking for a healthy environment and economic growth at the same time.

- Provide a tool kit of practical assistance, including workbooks, manuals, a database of projects, and computer software that can help planners improve the energy efficiency of their communities
- Link communities with peers who have undergone similar growth, and with experts from DOE/EERE’s national laboratories and programs to assist in solving technical problems
- Offer model codes and ordinances as well as sample community indicators and case studies for measuring progress toward sustainability.

Whether you call this new strategy “smart growth,” “livable communities,” or “sustainable development,” one of the keys is how communities use energy. ■

Join the Million Solar Roofs Initiative!

Million Solar Roofs is a Presidential Initiative to install solar energy systems on one million U.S. buildings by 2010. The Initiative includes two types of solar energy technologies: photovoltaics that produce electricity from sunlight and solar thermal panels that produce heat for domestic hot water, space heating, or swimming pools.

DOE/EERE is working on two fronts to carry out the initiative. The first involves a bottom-up approach—initiating partnerships with the building industry, utilities, the solar energy industry, financial institutions, state and local governments, other Federal agencies, and non-governmental organizations to remove market barriers and strengthen demand for solar energy. The second approach works from the top down—developing financing, leveraging resources, coordinating Federal agency support, and sharing information with partners. (For more information and a partial list of partners see page 4 or visit the Initiative’s Web site at www.MillionSolarRoofs.org.)

NREL/PIX 03442 BOB BOWER-SHOOT THE WORKS



Buildings for The 21st Century

NREL/PX 07081 HEDRICH-BLESSING—
COURTESY OF BURT HILL KOSAR RITTMANN ASSOCIATES



The wise use of energy in buildings and communities results in a healthier, more prosperous future.

The Grafton Middle School in Virginia Beach, Virginia, exemplifies the EnergySmart School concept with its daylighting design, advanced ventilation systems, and water-source geothermal heat pumps.

DOE Goes Back to School

In 1998, Secretary of Energy Bill Richardson and Secretary of Education Richard Riley announced the kickoff of a new initiative to save billions of dollars in school energy costs and redirect the savings toward student education. The EnergySmart Schools project is a partnership among government and educational institutions, public utilities, energy service companies, builders, equipment suppliers, national education and energy associations, and community groups.

Smart energy practices in both new and existing schools can help communities realize cost savings and return scarce taxpayer dollars to education. By reducing energy use, our schools could spend approximately \$1.5 billion more on books, computers, and teachers each year by the year 2010. As an added benefit, building improvements can result in better lighting conditions, healthier indoor air quality, and improved control of classroom temperature and ambient noise, all of which can improve the productivity and general well-being of students and teachers.

America's 81 million buildings—our homes, offices, park facilities, health clinics, hospitals, schools, factories, municipal centers, hotels, and convention centers—gobble up roughly \$230 billion worth of energy each year. Although we have become much more energy efficient in the past few decades, that's still about 36% of all the energy used annually in the United States. Researchers and engineers directed by DOE/EERE are intent on reducing those numbers.

Buildings for the 21st Century, an umbrella partnership between DOE/EERE and key players in the buildings industry, is creating a new generation of high-quality, affordable, and energy-efficient residential and commercial buildings. The partners—architects, designers, construction companies, community planners, finance companies, and equipment manufacturers—emphasize livability, comfort, and sustainable development to create a whole-building approach to new construction and renovation projects. They look at the way a building is designed, sited, constructed, and equipped, along with its functional purpose, to create maximum comfort and energy efficiency for its inhabitants. Through several DOE/EERE

programs, the partners approach buildings as integrated systems rather than as a conglomeration of independent pieces.

New Buildings and Old Retrofits

The Building America Program is the preeminent community resource for energy-efficient, affordable housing working with the Administration's Partnership for Advancing Technology in Housing (PATH). Building America works with home builders and all segments of the building industry to improve the quality and performance of new homes without increasing costs. Building America teams take advantage of the interaction between the building envelope and its mechanical systems to reduce home energy use by as much as 50% while maintaining comfort and quality. The teams include several Fortune 500 corporations and small business partners. Their goals are to build 2,000 new energy-efficient homes by the year 2000 and to see the integrated systems approach adopted in 70% of all new housing within 10 years. Today, homeowners spend a significant amount of their income on energy; Building America is helping to lower those bills.

DOE/EERE also helps communities retrofit existing commercial buildings. Working on a state and local level, Rebuild America helps community leaders and building owners access innovative technologies, industry services, customized assistance, and an array of business and technical tools needed for the retrofits. Rebuild America focuses on five building sectors: commercial, state and local government, K-12 schools, universities and colleges, and

Newly retrofitted, the state-of-the-art New Jersey State Aquarium will save taxpayers \$5.6 million over the next 15 years.



NREL/PIX 07329 NEW JERSEY STATE AQUARIUM

public and assisted housing.

Each year, nearly \$100 billion is spent on energy to heat, cool, and provide lighting and other building services to America's commercial buildings and multifamily housing. By forming Rebuild America partnerships that bring together local leaders, businesses, government, and industry to develop community energy action plans, more than 230 communities across the country are saving 20%–30% on their energy bills—and investing in their future by investing in energy efficiency. Their building renovation projects are helping business people, school districts, arts and cultural organizations, and public agencies put money back to work in the community—using savings to buy computers for schools and books for libraries, revitalize America's downtowns, and protect the environment.

Last year, more than 60,000 families reduced their energy costs and improved the quality of their homes through the DOE/EERE Weatherization Assistance Program. The program provides grants to states to help lower energy costs through retrofits and weatherization. In the past decade, the program's energy audits and improved weatherization practices have increased the energy savings in low-income households by 80% per dwelling. Through a network of state and local agencies, the

Weatherization Assistance Program not only saves energy, but also results in more than 9,000 jobs each year—jobs that help to strengthen local economies.

Smart Energy Use is Smart Government

Federal, state, and municipal government buildings consume more than \$8 billion worth of energy each year—enough to fuel the entire nation for 7 days or every sixth house in the country for an entire year. The Federal Energy Management Program (FEMP) helps make Federal facilities in communities across the country more efficient and less costly by helping Federal agencies install energy-efficient, renewable energy, and water conservation technologies. All of FEMP's initiatives save money for taxpayers, reduce waste, lower local energy consumption, and reduce air and water pollution.

At the state level, the DOE/EERE State Energy Program has provided grant funds to carry out more than 8,500 projects since 1976. The program designs grants that promote the adoption of high-potential energy technologies developed under DOE/EERE research programs. The funds are often distributed through state energy offices. For example, the City of Albuquerque, New Mexico, used a state energy

continued

Rebuild America—Getting Results

By 2003, Rebuild America communities will have generated \$3 billion in private community investment, created 26,000 new jobs, and saved \$650 million in energy costs every year. Rebuild partnerships are in action across the country, including:

- Rebuild Idaho has audited 1 million square feet in the Idaho Falls School District and saved one school \$8,500 in 10 days during a vacation shutdown demonstration.
- Rebuild Webster City, Iowa, has retrofitted 20 buildings, including several schools, municipal buildings, churches, and private businesses by leveraging a small amount of federal funding (less than \$50,000) into nearly \$5 million in energy-efficiency improvements.
- The city of Portland, Oregon, has completed retrofits on 35.8 million square feet of commercial buildings in its downtown.
- Rebuild Hawaii Island retrofitted the Hawaii County Building in Hilo and shows post-retrofit savings of nearly \$6,000 per month!
- The Central Ohio Energy Project began retrofitting 1.6 million square feet for energy efficiency and installing PV systems at 17 schools in the Worthington School District in Franklin County.



This home for Park Service employees at the Grand Canyon in Arizona incorporates solar design with a Trombe wall, structural insulating panels, high-performance ENERGY STAR® windows, an integrated mechanical system, and ENERGY STAR® appliances, reducing the annual heating need by more than 90%.

Counting to a Million Solar Roofs

The Million Solar Roofs Initiative, announced by the President in June of 1997, already has more than 30 state and community partnerships committed to developing preliminary plans for the installation of over 900,000 solar energy systems by the year 2010. The partnerships stretch from border to border, coast to coast and beyond, including:

CITIES AND COUNTIES

Albuquerque, New Mexico
Chicago, Illinois
Honolulu, Hawaii
Maui, Hawaii
Los Angeles, California
Philadelphia, Pennsylvania
Sacramento, California
San Diego, California

STATES & TERRITORIES

Arizona Maryland
California Oregon
Colorado Nevada
Florida Vermont
Hawaii Washington
Idaho Virgin Islands
Maine

UTILITIES

New England Electric
Service Companies
Sacramento Municipal
Utility District



This home, built in Vernon Hills, Illinois, by Town and Country Homes as part of DOE/EERE's Building America Program, has energy-efficient features such as advanced framing techniques, insulated sheathing, and an advanced ductwork system.

grant to install photovoltaic-powered lighting systems at 20 locations and 15 solar-powered, sprinkler-control systems in areas without electric distribution lines. The solar systems were more practical for the community because the cost of running lines to such remote locations was prohibitive.

What's Inside the Building Counts, Too

An electric water heater that supplies hot water for a family of four uses roughly the same amount of energy each year as a medium-size automobile driven 12,000 miles. Energy-efficient appliances on the market today offer consumers the opportunity to save on their energy bills. Increased consumer demand, in turn, encourages appliance manufacturers to introduce energy-efficient product lines. As consumers save and manufacturers profit, everyone benefits from lower energy consumption and reduced pollution.

The ENERGY STAR® Appliance Partnership Program is part of a joint effort between DOE/EERE and the Environmental Protection Agency. The program encourages the production and

marketing of high-efficiency home appliances to reduce air pollution and energy consumption. Leading retailers, including Sears, Circuit City, Montgomery Ward, and others are promoting refrigerators, dishwashers, and room air conditioners with the ENERGY STAR® label in their showrooms and newspaper ads. DOE/EERE and its ENERGY STAR® partners have recruited major utilities to share in the costs of these promotional programs. Retailers label qualifying appliances and display promotional posters, literature, and consumer education brochures on how to purchase energy-efficient products. As part of the program, DOE/EERE demonstrates new ENERGY STAR® technologies that offer much greater efficiencies, such as energy and water saving clothes washers, and arranges volume purchases of the new products to help speed market introduction and reduce costs to consumers.

ENERGY STAR® homes are also gaining popularity. Across the country, more than 700 builders and contractors, along with hundreds of other sustainable development allies, are participating in the program. The partners are building homes in every price category and region of the country—homes that average an estimated \$400 in energy savings each year. ■

Clean Power for the New Millennium

Every community has a unique combination of renewable energy resources that can supply part of its electricity.

NREL/PIX 00349 WARREN GRETZ



The cost of wind energy has decreased by a factor of three since 1985 to the point where wind is beginning to compete with conventional generation.

Polls have shown that our nation's citizens support clean power from renewable energy. This type of energy, which is inexhaustible, has very little impact on the environment. And new technologies are making renewable energy accessible to more of us every year.

The renewable resources available to any individual community or region depend on the local characteristics of geography, climate, and weather patterns. For example, most of the geothermal resources for producing electricity reside in California, Nevada, and Utah. Abundant biomass resources are available in the agricultural regions in the center of the country and the cultivated forests of the far North and Southeast. Although every region of the country has some wind resources, windy areas of the Great Plains are capable of producing many times the amount of electricity that is consumed locally. In addition, solar energy is available everywhere in varying degrees for diverse applications.

Community Energy

DOE/EERE plays a major role in developing and improving renewable technologies and in demonstrating how renewable energy can be the best source of power in many locales.

Wind Energy is the fastest growing electricity-generating source in the world. It leads the pack in part because of the dramatic reductions in the cost of energy from wind, which has been reduced by a factor of three in the last decade. Wind power plants are now on-line, planned, or under construction in 16 states.

Biomass is the largest non-hydro renewable energy resource in both the United States and the world. Today, 350 U.S. biomass power plants produce 7,000 megawatts of electricity, enough to meet the power needs of 2 million households. All these facilities use biomass obtained from plants and crops grown on nearby farms or from the residues generated

continued



NREL/PIX 06334 WARREN GRETZ

Wind turbines like this one at Lake Benton, Minnesota, occupy only about 2% of the land in a wind power plant. The rest of the land can be used for ranching and farming as it was before the turbines were installed.

Wind Moves Onto the Plains

When completed, more than 210 megawatts of wind-generating capacity will be available in the area around Lake Benton, Minnesota. In the summer of 1998, construction was completed on an initial 107-megawatt facility. By itself, this is the largest single wind installation in the world. Consisting of 143 wind turbines produced by Zond Energy Systems, Inc., a subsidiary of Enron Corporation of Tehachapi, California, the facility produces enough electricity to supply the needs of 36,000 households in southwestern Minnesota. Annual output is equivalent to burning 150,000 tons of coal, but sulfur dioxide emissions are reduced by 680 tons and oxides of nitrogen emissions are reduced by 650 tons per year. The wind power plant is spread out over 4,700 acres of land, yet uses only 2% of that land for turbine foundations, access roads, and other facilities, allowing the rest to be used for farming or ranching.



This 50-MW biomass power plant located in Anderson, California, runs on residues produced by nearby companies in the forest products industry.



This solar power plant located in the Mojave Desert in Kramer Junction, California, is one of nine such plants built in the 1980's. During operation, oil in the receiver tubes collects the concentrated solar energy as heat and is pumped to a power block located at the power plant for generating electricity.

by nearby forestry operations. As a result, using biomass to produce energy provides jobs in predominantly rural communities that have established agriculture and forestry enterprises.

Geothermal systems use the heat from the earth to produce electricity or to heat and cool buildings. The United States has 2,300 megawatts of geothermal generating capacity in California, Nevada, and Utah. In addition, close



This geothermal power plant located in the Imperial Valley in Southeastern California generates electricity from steam produced underground in the Salton Sea Geothermal Reservoir.

to 500,000 geothermal heat pumps currently operate in the United States, including almost 500 in our nation's schools.

Concentrating Solar Power produces electricity from heat energy generated by focusing sunlight to many times its normal concentration. Approximately 350 megawatts of solar power are generated in the Mojave Desert in California by power plants that have operated successfully for more than a decade. As the largest group of solar power stations in the world, these plants represent the bulk of the world's experience in utility-scale power generation from solar energy.

Photovoltaic (PV) modules produce electricity directly from sunlight. PV systems can come in almost any size, and because of its great modularity, PV can be configured in a number of ways. Its great flexibility is making PV the power of choice for a steadily increasing number of applications.



The City of Littleton, Colorado, uses solar energy from PV to irrigate newly planted trees in a 1.7-mile revegetation project along the South Platte River. The city chose PV because it was the least expensive source of electricity for this application.

Teaming Up with Local Utilities

DOE/EERE supports the Utility Photovoltaic Group (UPVG) in its efforts to accelerate utility acceptance of PV technology. Since 1994, UPVG has managed TEAMUP (Building Technology Experience to Accelerate Markets in Utility Photovoltaics). TEAMUP, which is helping to develop commercial markets for PV in the United States, is a partnership between the utility industry and DOE/EERE.

Since 1995, TEAMUP has funded 39 business ventures, representing 130 partners. These ventures will significantly augment the experience of electric utilities and their customers with PV, resulting in increased demand for solar power across the nation. DOE/EERE has invested more than \$15 million in partnerships that will lead to more than 2,500 PV installations in as many as 35 states. And the Federal investment is leveraged by more than \$58 million in investments from private industry. These solar installations, totaling more than 8 megawatts of power, will stimulate markets that will reduce the cost and increase large-scale deployment of PV systems.



These roof shingles being installed in Golden, Colorado, are coated with PV cells made of amorphous silicon. When installation is complete, as pictured above on the Southface house in Atlanta, Georgia, the PV shingles look much like ordinary roofing shingles, but they generate electricity.



Sustainable Future

Many believe that the restructuring of the power industry presents consumers with a unique opportunity to choose their power supplier, and in doing so, make the clean power choice. As this happens, new technologies open the doors of opportunity in the electric power industry. As a result, energy efficiency and renewable energy are becoming part of the foundation of sustainable growth for contemporary communities.

To prepare for our energy future, DOE/EERE is also investigating other sustainable energy options. Research in superconductivity, energy storage, hydrogen fuel, and transmission reliability during the transition to competitive markets in the power industry will lead us to even greater energy savings. ■

Silent Rooftop Generators

In a innovative product recently developed through research sponsored by DOE/EERE, PV is made part of the roof of a building. In this application, roof shingles being made in the factory are covered with amorphous silicon PV cells. During roof construction, the shingles are attached like an ordinary roof, except the wires are connected to the electrical system underneath the house. When the sun shines, the roof generates electricity for the building. In this way, two products (whose cost depends on the area covered) are combined into one, adding value to both and reducing the total per-area cost.



Industries of the Future

In communities across the nation, industry is slashing energy use.



Developed with support from NICE³, Solex Environmental Systems of Houston, Texas, developed a robotics system that inspects above-ground storage tanks containing petroleum and other petrochemicals while they remain in service. By 2010, the technology could provide energy savings approaching 12 trillion Btu.

Saving Money While Reducing Hazardous Waste

Hydrochloric acid (HCl), which requires costly transport and disposal, is a toxic and corrosive chemical used to clean new steel and remove rust. In 1993, NICE³ awarded Beta Control Systems, Inc., of Beaverton, Oregon, along with the Oregon Department of Energy, a \$97,000 cost-shared grant to help commercialize an HCl recovery system. The Beta system reduces cleaning costs from \$14.00 to \$3.40 per ton, and saves an estimated 24 billion Btu per year over conventional transportation and disposal energy use. The life expectancy of the system exceeds that of conventional systems by 3 years, and payback is achieved in less than 1.5 years.

Driven by competitors, prodded by investors, and prompted by consumers, American industry has undergone a quiet revolution in the past decade. Today, our nation's factories are doing more with less, sometimes substantially less. And they are stronger for it.

Energy use offers one of the best examples. By installing more efficient equipment and running it smarter, the energy needed for virtually every manufacturing operation is less than it has ever been. Although this has resulted in direct savings for the companies involved, energy savings are only the beginning. Lower energy use also reduces costs and pollution, cuts waste, raises productivity, and improves product quality.

States and local communities across the nation are helping to mobilize their local industries to adopt the Industries of the Future (IOF) strategy, a partnership process that promises to continue advances in energy efficiency. Armed with a common agenda of technology develop-

ment and deployment priorities, partnerships involving public agencies, private companies, and nonprofit organizations are formed to carry out the necessary work. By joining the national-level IOF effort, these communities simultaneously improve their relationships with industry and strengthen their local economies.

NICE³ Demonstrates New Technologies With Local Industry

Several Federal programs have supported industry efforts by funding innovations and demonstrations that encourage cost savings, improve productivity, and increase competitiveness. The National Industrial Competitiveness through Energy, Environment, Economics (NICE³) Program provides grants to state and industry partners to help demonstrate energy-efficient and clean technologies in the early stages of commercialization. Since 1991, NICE³ has supported 91 projects with \$26.3 million of DOE/EERE funding, and more than half the grants go to small businesses. This investment has leveraged more than \$81.8 million in additional funding from states and private companies for these projects.

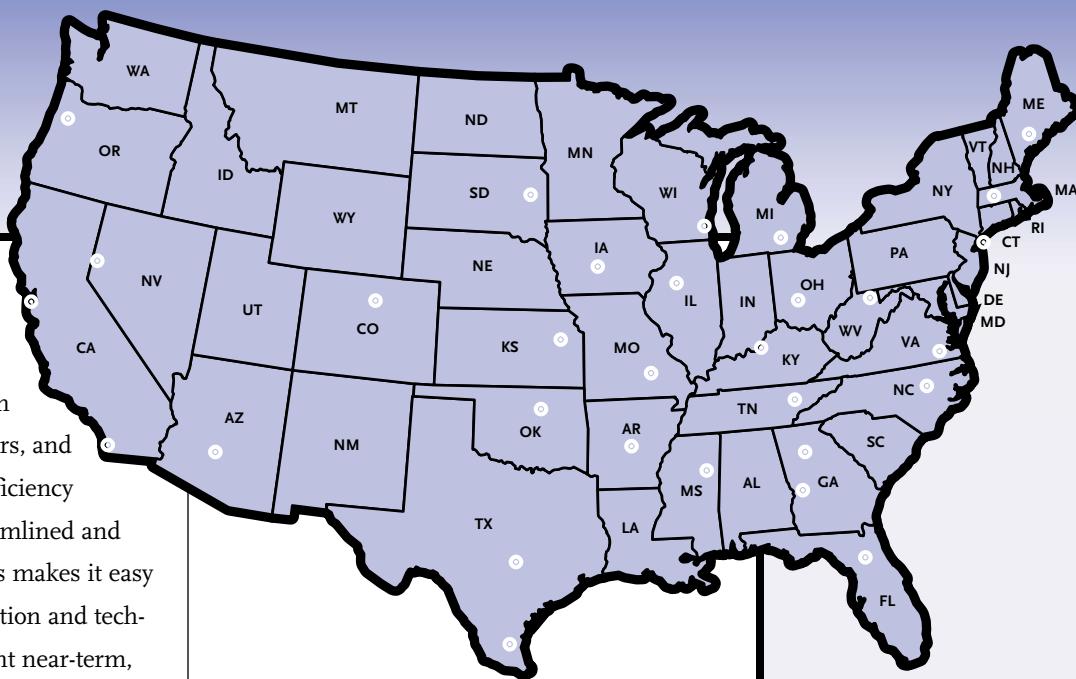
IOF BestPractices

Industrial processes driven by motors, steam, or compressed air, along with heating systems, are among the most energy-consuming segments of plant operation. As a result, improvements in these areas often yield immediate savings of energy and materials, freeing up dollars that flow directly to the bottom line.

The benefits compound when the improvements are part of a systems approach. The IOF BestPractices approach works with industry, equipment manufacturers, and distributors to promote energy efficiency through integrated systems. Streamlined and comprehensive, IOF BestPractices makes it easy for industry to access the information and technical support needed to implement near-term, energy-efficient, clean manufacturing technologies. DOE/EERE plays a unique role in providing unbiased technical data, flexible training materials, neutral forums for information exchange, networking opportunities, and coordination with other Federal agencies.

No-Cost Energy Assessments

DOE/EERE sponsors Industrial Assessment Centers located at 30 universities across the country. These centers provide small and medium-size manufacturers with no-cost energy assessments. In addition to energy reduction, the assessments include recommendations for productivity improvements and waste reduction. Working under the supervision of senior engineering professors, some of the brightest engineering students in the country earn on-the-job training by performing about 750 assessments a year. At the same time, participating manufacturers have access to a database of more than 8,000 energy assessments that shows recommendations that have worked at other plants. Implemented savings average \$55,000 per year for each participant. ■



Industrial Assessment Centers Across the Country

University of Arizona
Mississippi State University
Old Dominion University
University of Michigan
Bradley University
University of Nevada at Reno
South Dakota State University
Texas A&M
Colorado State University
University of Dayton
University of Florida at Gainesville
Georgia Institute of Technology
Hofstra University of Long Island
Iowa State University at Ames
University of Kansas
University of Louisville
University of Massachusetts at Amherst
University of Missouri at Rolla
Notre Dame University
Oklahoma State University
Oregon State University
University of Tennessee
Texas A&M University
San Diego State University
University of Wisconsin at Milwaukee
University of Arkansas at Little Rock
University of Maine
North Carolina State University
San Francisco State University
University of West Virginia

City Gains \$96,000

An initial investment of \$16,000 to replace a booster pump at 1 of its 37 sewage stations brought the City of Milford, Connecticut, a return of \$96,000. The sum represents the net present value of the annual savings in energy, supply, and labor minus the investment. By reducing overall energy consumption at the station by 15%, the pump improvement paid for itself in less than 2 years. The project was organized as a partnership among DOE's Motor Systems Program, ITT Flygt Corporation of Trumbull, Connecticut, and the United Illuminating Power Company of New Haven, Connecticut. Project engineers achieved the high level of savings by investigating total system performance at the station before replacing the pump.

Community Transportation Choices

Clean fuels will drive the next generation of vehicles through the 21st century.

NREL/PIX 06171 WARREN GRETZ



Electric vehicles, such as this one from Chattanooga, Tennessee, make good sense for buses and delivery vehicles that start and stop often.

General Motors Corporation's EV-1, the first electric vehicle produced by a major U.S. manufacturer in 50 years, was introduced in the market in 1996.



NREL/PIX 03970 GENERAL MOTORS CORPORATION

The Next Generation of Vehicles

In addition to promoting Alternative Fuel Vehicles (AFVs) for today's drivers, DOE/EERE has a portfolio of projects that create breakthroughs in increased fuel efficiency and reduced emissions without sacrificing performance:

- Hybrid vehicles
- Advanced batteries
- Lightweight materials
- Emissions controls
- Fuel-efficient engines
- Fuel cells
- Natural gas products

AFVs can run on various fuels such as biodiesel, electricity, ethanol, hydrogen, natural gas, methanol, and propane.

Communities across the country are using alternative fuel vehicles (AFVs) to reduce air pollution and decrease emissions of carbon dioxide and other gases that contribute to global climate change. In addition to environmental benefits, using AFVs and other advanced vehicle technologies helps to reduce the country's dependence on imported oil.

Recognizing the multiple benefits of alternative fuels, Congress passed the Energy Policy Act of 1992 to encourage greater use of AFVs, with several large fleets designated to take the lead in AFV use. For example, in 1999, 75% of new Federal agency vehicles must be AFVs. In other fleets, 70%, 50%, and 25%, respectively, of the new vehicles purchased by natural gas utilities, electric utilities, and state governments must be

AFVs. Under certain conditions, 50% of new vehicles purchased by companies that produce or provide propane, methanol, and ethanol (called "fuel providers") must also be AFVs.

In partnership with Federal, state, and local officials, automobile manufacturers, energy companies, and fleet owners, DOE/EERE sponsors several programs designed to increase the use of AFVs. By providing information on vehicle performance, cost, and environmental impact, and by encouraging AFV purchases by managers of vehicle fleets, DOE/EERE's community transportation programs help increase user confidence in these new technologies. And its research and development partnerships perform high-risk research and development of innovative transportation technologies to develop a new generation of vehicles.

Alternative Fuels Mean Cleaner Cities

The Clean Cities Program brings AFV providers and customers together to promote increased sales of AFVs, primarily in niche markets and fleets where they can be most competitive. Working together at the community level helps to overcome the chicken and egg problem normally associated with investments in new technologies. As the program grows, support for corridors that link Clean Cities along major interstate highways and commercial routes will enable more and more commercial fleets to use alternative fuels. This expanding refueling infrastructure and choice of vehicles will make alternative fuels and advanced vehicle technologies more attractive to the public.

Flexible-fuel vehicles, such as this 1999 E85 Ford Ranger, can run on ethanol or gasoline, giving drivers a choice of fuels at no extra cost.



NREL/PIX 05149
FORD MOTOR COMPANY

In the past 5 years, the Clean Cities network has grown significantly. Many cities have learned that niche markets, such as taxis, airport shuttles, and school buses, offer an untapped AFV market.

Since the inception of Clean Cities:

- AFVs on the road have increased more than 50%
- Alternative fuel refueling stations have almost doubled
- Thirty states now offer financial incentives to help encourage AFV use
- Models of light-duty AFVs have increased from 3 to 28. The number of heavy-duty engines that are capable of running on alternative fuels has increased from 2 to more than 10
- DOE/EERE has provided more than \$12 million in grants to help Clean Cities coalitions get started, offset the extra cost of vehicles, and establish refueling sites. Most of these funds were cost-shared with the coalitions. More than \$275 million in funding for alternative fuel projects has come from the Federal Highway Administration's Congestion Mitigation and Air Quality (CMAQ) Program (known as TEA-21).

Clean Cities Works for Communities

Across the country, 70 cities have partnered with more than 3,600 stakeholders to commit to the goals of the Clean Cities Program.

This school bus in San Antonio, Texas, runs quietly and efficiently with low emissions on natural gas. This translates into extra money for local education programs.



NREL/PIX 04152 JOHN KUBESCH

Here are some examples:

- In Philadelphia, Pennsylvania, more than 50 school buses in the Lower Merion School District now operate on compressed natural gas
- In Atlanta, Georgia, Checker Cab Company operates more than 70 taxis on natural gas, and Georgia Power is putting more than 300 electric vehicles on local roads
- In El Paso, Texas, the U.S. Postal Service delivery fleet is 100 percent powered by natural gas
- In San Antonio, Texas, six propane-powered streetcars add diversity to the public transit system
- In Chicago, Illinois, 10 ethanol refueling stations are under development for flexible-fuel vehicles
- In Sacramento, California, the Interstate Clean Transportation Corridor has launched 9 liquid natural gas (LNG) fueling stations that will service more than 100 LNG trucks.

Look around. Advanced technology vehicles may already be on the road in your area. ■

Resources

DOE/EERE supports Clean Cities initiatives by providing experienced regional staff to help communities get started or expand their efforts. The initiative provides grant money to help purchase AFVs and construct alternative fuel refueling sites. It also places public service announcements to generate local awareness, publishes guides for fleet buyers, staffs an AFV hotline, and provides a wide range of information resources to help make AFV purchasing decisions easier.

If you want to join the Clean Cities network, attend Clean Cities conferences, apply for state energy grants, learn how to apply for a CMAQ grant, obtain information on alternative fuels, or learn about the latest developments in vehicle research and development, contact your regional DOE representative (see page 12), call 800-CCITIES (800-224-8437), or visit the Clean Cities Web site at www.ccities.doe.gov.

Helping Communities Find Solutions

NREL/PX 03604 WARREN GRETZ



DOE/EERE works through partnerships to help foster livable communities.

Communities of the Future

DOE/EERE's regional offices are planning a major expansion of their community partnership efforts. In the new century, the regional offices will engage in intensive consultation with local and state governments to define and develop Communities of the Future. By coordinating their efforts with other Federal agencies, the regional offices will bring community developers a more comprehensive and effective portfolio of Federal services.

DOE/EERE's regional offices provide information, advice, technical assistance, and financial grants for applying innovative, local solutions to sustainable development.

Air quality, community redevelopment, affordable housing, business retention, economic revitalization, livability—communities face a daunting set of challenges. And often, the biggest is “Where do we start?”

DOE/EERE can help. Six regional offices were created and staffed to help your community find innovative ways to use energy efficiency and renewable energy to meet your challenges. Our offices in Atlanta, Boston, Chicago, Denver, Philadelphia, and Seattle work with states and communities throughout the country to identify the energy efficiency and renewable energy solutions that fit local needs. These offices can also help communities find the information and resources available through State Energy Offices and other Federal agencies.

Our regional offices have built working partnerships with communities ranging from Los Angeles and Chicago, to Albuquerque, Chattanooga, Burlington, and Baltimore, each designed to serve specific local needs. We have helped develop local solutions to issues as varied as urban sprawl, natural disaster mitigation and relief, air quality, utility restructuring, brownfield redevelopment, affordable housing, and downtown redevelopment.

DOE/EERE is not just about cutting-edge technology. It's also about solutions. The DOE/EERE regional offices are a great place to start building the solutions that make sense for your community. ■

DOE/EERE Regional Offices

Atlanta Regional Office

James R. Powell, Director
703 Peachtree St., NE, Ste. 876
Atlanta, GA 30308-1212
404-347-2696
www.eren.doe.gov/arso

Boston Regional Office

Hugh Saussy, Jr., Director
Room 675
JFK Federal Building
Boston, MA 02203-0002
617-565-9700
www.eren.doe.gov/brso

Chicago Regional Office

Val Jensen, Director
One South Wacker Drive, Ste. 2380
Chicago, IL 60606-4616
312-353-6749
www.eren.doe.gov/crso

Denver Regional Office

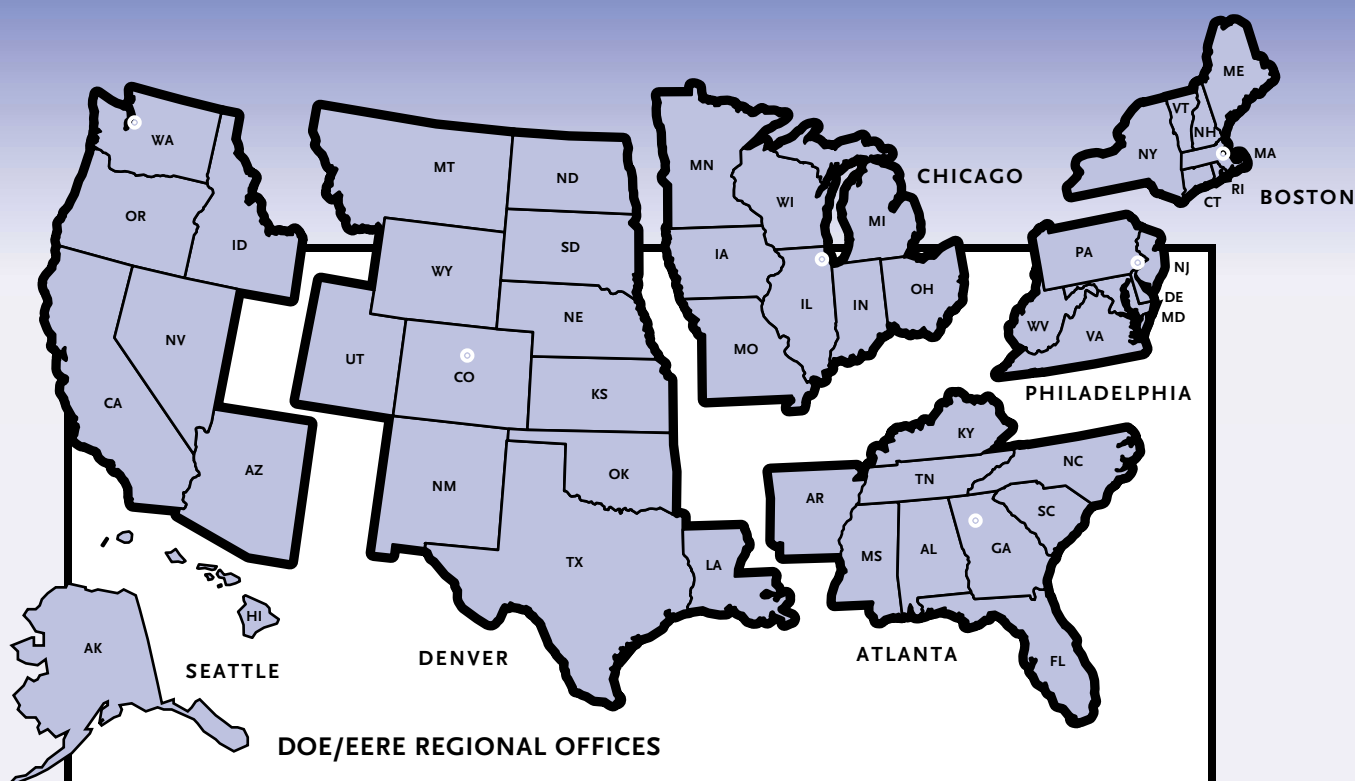
William Becker, Director
1617 Cole Blvd.
Golden, CO 80401-3393
303-275-4826
www.eren.doe.gov/drso

Philadelphia Regional Office

Anthony P. Pontello, Acting Director
1880 JFK Blvd., Ste. 501
Philadelphia, PA 19103-7483
215-656-6950
www.eren.doe.gov/prso

Seattle Regional Office

Kathleen Vega, Director
800 Fifth Avenue, Ste. 3950
Seattle, WA 98104-3122
206-553-1004
www.eren.doe.gov/srso



NATIONAL ASSOCIATION OF STATE ENERGY OFFICIALS (NASEO)

| | | | | | |
|---|---|---|---|---|--|
| Alabama Terri Adams 334-242-5333 | Georgia Paul Burks 404-656-0938 | Maryland Frederick Hoover Jr. 410-260-7511 | Nebraska Larry Pearce 402-471-3531 | Rhode Island Janice McClanaghan 401-222-3370 | Wisconsin Nathaniel E. Robinson 608-266-8234 |
| Alaska Robert Brean 907-338-6100 | Hawaii Maurice Kaya 808-587-3812 | Maine Shirley Bartlett 207-287-8462 or Laurie Lachance 207-287-3261 | New Hampshire Deborah Schachter 603-271-2611 | South Carolina Mitch Perkins 803-737-8030 | West Virginia John F. Herholdt Jr. 304-558-0350 |
| Arizona Amanda Ormond 602-280-1402 | Iowa Larry Bean 515-281-8681 | Michigan Tom Martin 517-373-7486 | New Jersey Robert Chilton 973-648-3621 | South Dakota Ron Wheeler 605-773-5032 | Wyoming John Nunley 307-777-2804 |
| Arkansas Morris Jenkins 501-682-7377 | Idaho Robert Hoppie 208-327-7968 | Minnesota Michael Roelofs 651-296-6025 | New Mexico Mary Joy Ford 505-827-5957 | Tennessee Cynthia Oliphant 615-741-2994 | Northern Mariana Islands Juan A. Camacho 670-322-9229 |
| California William J. Keese 916-654-5000 | Illinois Mitch Beaver 217-785-2800 | Missouri Anita Randolph 573-751-2254 | Nevada DeeAnn Parsons 702-687-4910 | Texas Tobin Harvey 512-463-1931 | Puerto Rico Daniel Pagan Rosa 787-724-8774 |
| Colorado Rick Grice 303-620-4292 | Indiana Cheryl DeVol-Glowinski 317-232-8939 | Mississippi Chester Smith 601-359-6600 | New York William Valentino 518-862-1090 | Utah Jeff Burks 801-538-5414 | U.S. Virgin Islands Trudy E. Green 340-772-2616 |
| Connecticut Allan Johanson 860-418-6297 | Kansas Jim Ploger 785-271-3349 | Montana Art Compton 406-444-6754 | Ohio Sara Ward 614-466-6797 | Virginia Stephen A. Walz 804-692-3211 | American Samoa Reupena Tagaloa 684-699-1101 |
| Washington, DC Charles J. Clinton 202-673-6710 | Kentucky John Stapleton 502-564-7192 | North Carolina T.C. Adams, III 919-733-1889 | Oklahoma Brenda Williams 405-815-5352 | Vermont Richard Sedano 802-828-2321 | Guam Fred Camacho 671-477-0557 |
| Delaware Charles Smission 302-739-5644 | Louisiana Paula Ridgeway 225-342-1399 | North Dakota Dina Butcher 701-328-2094 | Oregon John Savage 503-378-4131 | Washington Kristine Growdon 360-956-2062 | |
| Florida Jim Tait 850-922-6074 | Massachusetts David L. O'Connor 617-727-4732, x122 | | Pennsylvania Rose Mape 717-783-0540 | | |

For More Information

Write us at:

U.S. Department of Energy, EE-1
Office of Energy Efficiency and
Renewable Energy
1000 Independence Ave., S.W.
Washington, DC 20585-0121

To obtain print copies of this document or any DOE/EERE publications contact:

Energy Efficiency and Renewable Energy
Clearinghouse (EREC)
P.O. Box 3048
Merrifield, VA 22116
Fax: (703) 893-0400
BBS: (800) 273-2955
Phone: (800) DOE-EREC
(800-363-3732)
E-mail: doe.erec@nciinc.com

Visit our Web sites at:

- Energy Efficiency and Renewable Energy Network (EREN)
www.eren.doe.gov
- Million Solar Roofs Initiative
www.MillionSolarRoofs.org
- EnergySmart Schools Initiative
www.eren.doe.gov/energysmartschools
- Center of Excellence for Sustainable Development
www.sustainable.doe.gov
- DOE/EERE's Regional Offices
www.eren.doe.gov/rso.html
- Office of Building Technology, State and Community Programs
www.eren.doe.gov/buildings
- State Energy and Weatherization Programs
www.eren.doe.gov/buildings/state_and_community
- Office of Power Technologies
www.eren.doe.gov/utilities
- State Energy Alternatives
www.eren.doe.gov/state_energy
- Green Power Network
www.eren.doe.gov/greenpower
- Office of Industrial Technologies
www.oit.doe.gov
- Industries of the Future
www.oit.doe.gov/industries.html
- NICE³
www.oit.doe.gov/nice3
- Office of Transportation Technologies
www.ott.doe.gov
- Clean Cities
www.ccities.doe.gov
- Alternative Fuels Data Center
www.afdc.doe.gov
- ENERGY STAR®
www.energystar.gov



Produced for the U.S. Department of Energy (DOE)
By the National Renewable Energy Laboratory,
A DOE national laboratory

DOE/GO-10099-757
April 1999



PRINTED ON PAPER CONTAINING AT LEAST 50% WASTEPAPER,
INCLUDING 20% POSTCONSUMER WASTE

COVER PHOTOS: NREL/PIX 05593, COURTESY OF GREENMOUNTAIN POWER CORPORATION;
NREL/PIX 07319 COURTESY OF THE U.S. DEPARTMENT OF ENERGY; NREL/PIX 04473 TIM ELLISON-
ECD; AND NREL/PIX 04036 PIERCE TRANSIT